Selecting the Metal Seal Material

The tables below and opposite list all the available materials for non-spring energized seals and spring energized seals.

Starting in the column appropriate to the chosen metal seal type, make the primary material selection by choosing a "preferred", or possibly "optional" material compatible with the maximum working temperature in the application. Information on temperature resistance is given on the following pages.

Other factors that may also require consideration include 'NACE' approval (corrosion resistance) and chemical compatibility. Additional guidance on the effects of material choices on seal performance (load, springback and pressure rating) may be found on pages E-69 to E-77.

Special materials are also available to meet unusually severe operational requirements, or unique procurement specifications. Generally, these will not be stock item materials and may be subject to some additional lead time and material lot charges.

EXX - 000000 - 00 - 00 - 0 - XXX

Material Code

Non-Spring Energized Seals

Material Code	Material (Common Designation)	NACE Approved *(See Note 3)*	C-Ring	E-Ring	O-Ring	U-Ring	Wire Ring
01	304 Stainless Steel				**Preferred**[1]		**Preferred**
02	316 Stainless Steel				Special		Special
03	321 Stainless Steel				**Preferred**[1]		Special
04	347 Stainless Steel				Special		Special
15	Stainless Steel Alloy A-286		Special				
16	17-4 PH Stainless Steel		Special				
06	Alloy 600				Special		
25	Alloy 625		Special				
14	Alloy 718	Yes	**Preferred**	**Preferred**	Optional[2]	**Preferred**	Special
07	Alloy X-750		Optional	Optional	Optional[2]	Optional	Special
20	Hastelloy C-276	Yes	Special				
23	Waspaloy		Optional	Optional		Optional	
29	Rene 41		Special	Special		Special	
05	Monel 400				Special		Special
39	Haynes 188		Special			Special	
09	Haynes 25		Special		Special		
08	Aluminum Alloy 1100						**Preferred**[4]
12	Copper						Special
13	Nickel						**Preferred**[4]

1: 321 Stainless Steel is standard for 0.125 inch and smaller free height metal O-rings. 304 Stainless Steel is standard for 0.156 inch and larger free height metal O-rings.
2: Alloy X-750 is optional for 0.250 inch and smaller free height metal O-rings. Alloy 718 is optional for 0.375 inch and larger free height metal O-rings.
3: Approved for use in corrosive seal service per NACE MR-01-075 specification.
4: 3/32 free height wire rings are only available in stainless steel, nickel, and nickel alloys.

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Spring Energized Seals				
Material Code	Jacket/Spring Material Combination (Common Designation) Jacket/Spring	NACE Metal C-Ring Approved *(See Note 3 on previous page)*	Spring Energized Metal C-Ring 	Spring Energized Metal O-Ring 
01	304 Stainless Steel / 304 Stainless Steel		Optional	**Preferred**
02	304 Stainless Steel / Cobalt Chromium-Nickel Alloy		Special	
03	Alloy X-750 / Cobalt Chromium-Nickel Alloy		Special	
04	Aluminum Al 1100-0 / 304 Stainless Steel		Special	
05	Alloy X-750 / 304 Stainless Steel		Special	
06	Alloy X-750 / Alloy X-750		**Preferred**	Special
07	304 Stainless Steel / Alloy X-750		Optional	
08	304 Stainless Steel / Nimonic 90		Special	
09	Alloy X-750 / Nimonic 90		Special	
10	Alloy X-750 / Alloy 718		Optional	
11	Alloy 718 / Alloy 718	Yes	Optional	
12	Alloy 718 / Alloy X-750	Yes	Optional	
13	Nickel / Alloy X-750		Special	
14	Alloy 718 / Cobalt Chromium-Nickel Alloy		Special	
15	Cobalt Chromium-Nickel Alloy / Cobalt Chromium-Nickel Alloy		Special	
16	Alloy C-276 / Alloy C-276		Special	
17	Alloy 625 / Alloy 625		Special	

Other materials are available upon special request. Please contact one of our applications engineers for assistance.

Temperature Capability

Stainless Steel

Material	UNS No.	AMS Specifications				Description	Maximum Recommended Service Temperature	Typical Usage
		Strip & Sheet	Tubing	Wire Rings	Wire Spring			
304/304L	S30400	AMS 5511, AMS 5513	AMS 5560, AMS 5565	AMS 5697	AMS 5857	The most commonly used stainless steel alloy. Excellent formability and good corrosion resistance. Found in a wide variety of commercial, industrial and consumer applications.	600°F (316°C)	C-rings, O-rings and wire rings in cryogenic to moderate temperature applications requiring mild corrosion resistance.
316/316L	S31600		AMS 5597	AMS 5690		The addition of molybdenum offers improved corrosion resistance when compared to 304/304L. These alloys also offer enhanced creep, stress-to-rupture, and tensile strengths at elevated temperatures.	600°F (316°C)	
17-4PH	S17400	AMS 5604				A chromium-nickel-copper, precipitation hardenable martensitic stainless steel used for applications requiring high strength and a moderate level of corrosion resistance.	600°F (316°C)	
321	S32100		AMS 5570, AMS 5576	AMS 5689		Stabilized by the addition of titanium, this alloy provides excellent resistance to intergranular corrosion following prolonged exposure to elevated service temperatures.	800°F (427°C)	
347	S34700			AMS 5674		Stabilized by the addition of columbium and tantalum. Offers increased resistance to sensitization compared to alloy 321.	800°F (427°C)	
Alloy 286	S66286	AMS 5525				Designed for applications requiring high strength with good corrosion and oxidation resistance at moderately high temperatures. This precipitation-hardenable alloy provides a high degree of uniformity in developing maximum strength, which can be duplicated application after application.	1200°F (649°C)	C-rings in more severe environments requiring enhanced strength, corrosion and oxidation resistance.

Selecting the Metal Seal Material

Temperature Capability								
Nickel Alloys								
Material	UNS No.	AMS Specifications				Description	Maximum Recommended Service Temperature	Typical Usage
		Strip & Sheet	Tubing	Wire				
				Wire Rings	Spring			
Monel® 400	N04400		AMS 4574	AMS 4730		A ductile nickel-copper solid-solutioned-strengthened alloy with good general corrosion resistance in a wide range of media. Slightly magnetic at room temperature.	600°F (316°C)	C-ring applications requiring corrosion resistance to specific environments.
Alloy 276	N10276	AMS 5530				A nickel-molybdenum-chromium alloy offering superior corrosion resistance. Excellent resistance to pitting and stress corrosion cracking. Suitable for a wide variety of chemical processing environments.	1000°F (538°C)	C-ring applications requiring the utmost in corrosion protection.
Alloy 600	N07600		AMS 5580			A nickel-chromium alloy with good oxidation resistance at moderate service temperatures. Good resistance to carburizing and chloride containing environments.	1000°F (538 °C)	C-ring applications requiring corrosion resistance to specific environments.
Alloy 625	N07625	AMS 5599				A solid-solution-strengthened, nickel-chromium-molybdenum alloy with good high-temperature strength. Offers good oxidation resistance and excellent corrosion resistance.	1000 °F (538°C)	
Nimonic® 90	N07090				AMS 5829	A nickel-chromium-cobalt alloy being precipitation hardenable, having high stress-rupture strength and creep resistance at high temperatures	1000°F (538°C)	Spring material for spring-energized C-rings.
Alloy X750	N07750	AMS 5598	AMS 5582		AMS 5699	An age-hardenable nickel-based superalloy with good high-temperature strength. Readily cold-formed using standard forming techniques.	1100°F (593°C)	These materials are useful for all seal types up to their maximum service temperature. Particularly suitable for gas turbine and aerospace applications with large thermal and mechanical transients.
Alloy 718	N07718	AMS 5596	AMS 5590			An age-hardenable nickel superalloy with excellent high-temperature strength and good oxidation resistance. Excellent cold-forming characteristics. Higher strength than Alloy X750 with improved weldability.	1200°F (649°C)	
Waspaloy	N07701	AMS 5544				An age-hardenable nickel-based superalloy with very good high-temperature strength and oxidation resistance at service temperatures up to 1350°F (732°C). Strength is superior to Alloy 718 above 1150°F.	1350°F (732°C)	
Rene 41	N07041	AMS 5545				An age-hardenable nickel-based superalloy with superior strength up to 1450°F (788°C).	1450°F (788°C)	
Haynes® 230	N06230	AMS 5878				A solid-solutioned-strengthened, nickel-chromium-tungsten-molybdenum alloy with good high-temperature strength and excellent oxidation resistance. Excellent thermal stability and resistance to nitriding environments.	1600°F (871°C)	Not as strong as the age-hardenable nickel alloys, these materials are useful where long term oxidation resistance is a prime concern.
Haynes® 214	N/A (DIN 17744-2.4646)					A nickel-chromium-aluminum-iron alloy with superior high-temperature oxidation resistance and very good high-temperature strength. Highly resistant to carburizing and nitriding environments.	1800°F (982°C)	

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Temperature Capability [cont.]

Cobalt Alloys

Material	UNS No.	AMS Specifications				Description	Maximum Recommended Service Temperature	Typical Usage
		Strip & Sheet	Tubing	Wire				
				Wire Rings	Spring			
Elgiloy® Cobalt-Chromium-Nickel Alloy	R30003	AMS 5876			AMS 5833	This cobalt-chromium-nickel alloy gives a combination of high strength, ductility and good mechanical properties and is age hardenable. Excellent fatigue life and corrosion resistance in numerous environments.	700°F (371°C)	Approved high strength spring material for sour gas application.
Haynes® 25	R30605	AMS 5537				A solid-solution-strengthened, cobalt-nickel-chromium-tungsten alloy with very good resistance to high-temperature oxidizing environments. Largely replaced by Haynes 188 and Haynes 230.	1600°F (871°C)	High temperature C-ring applications. High wear C-ring applications.
Haynes® 188	R30188	AMS 5608				A cobalt-nickel-chromium-tungsten alloy with very good resistance to high-temperature oxidizing environments. Better thermal stability than Haynes 25 with similar high-temperature strength.	1600°F (871°C)	High temperature C-ring applications.

Temperature Capabilities

Other Materials

Material	UNS No.	AMS Specifications				Description	Maximum Recommended Service Temperature	Typical Usage
		Strip & Sheet	Tubing	Wire				
				Wire Rings	Spring			
Indium	N/A					Commercially pure (> 99.9%) Indium	150°F (66°C)	Electroplated in various combinations to provide aductile outer layer that enhances seal-ability and/or corrosion. Occasionally used for wire rings.
Lead	N/A					Commercially pure (> 99.9%) Lead	400°F (204°C)	
Teflon®	N/A					Chemically inert polymer. Highly resistant to chemical attack.	500°F (260°C)	Near net-shape electroplated anti-wear coatings. Used to prolong seal life in applications with high thermal, mechanical or vibrational movement.
Copper	C11000					Commercially pure (> 99.0% copper). Fair corrosion resistance.	600°F (316°C)	Electroplated in various combinations to provide aductile outer layer that enhances seal-ability and/or corrosion. Occasionally used for wire rings.
Nickel 200	N02200					Commercially pure (> 99.9%) Nickel	600°F (316°C)	Low-temperature wire rings.
Aluminum Alloy 1100	A91100					Commercially pure (> 99.0%) aluminum. Good corrosion resistance and high formability.	1000°F (538°C)	Machined seals.
Silver	N/A					Commercially pure (> 99.9%) Silver	1200°F (650°C) Oxidizing 800°F (425°C) non-oxydizing	Electroplated in various combinations to provide aductile outer layer that enhances seal-ability and/or corrosion. Occasionally used for wire rings.
TriCom®	N/A					A cobalt-chrome-carbide anti-wear coating with a low coefficient of friction and good oxidation resistance.	1200°F (649°C)	Near net-shape electroplated anti-wear coatings. Used to prolong seal life in applications with high thermal, mechanical or vibrational movement.
Nickel 201	N02201					Low-carbon version of Nickel 200. Preferable for application tempera-tures above 600°F (316°C).	1400°F (760°C)	High-temperature wire rings.
Gold	N/A					Commercially pure (> 99.9%) Gold	1700°F (927°C)	Electroplated in various combinations to provide aductile outer layer that enhances seal-ability and/or corrosion. Occasionally used for wire rings.
Tribaloy® T-400	N/A					Cobalt-chromium-molybdenum alloys offering excellent wear resistance at extreme temperatures.	1800°F (982°C)	HVOF plasma-sprayed anti-wear coatings for extreme environments. May require post-coating machining to meet design tolerances.
Tribaloy® T-800	N/A						1800°F (982°C)	
Nickel	N/A					Commercially pure (> 99.9%) Nickel	2200°F (1204°C)	Electroplated in various combinations to provide aductile outer layer that enhances seal-ability and/or corrosion. Occasionally used for wire rings.